IN THE SPECIFICATION

Please amend paragraphs **[0004]**, **[0005]**, **[0006]**, **[0021]**, **[0022]**, **[0026]**, **[0027]**, **[0030]**, **[0032]**, **[0037]**, **[0038]**, **[0039]**, **[0040]**, **[0041]**, **[0042]**, and the **Abstract** of the specification as indicated below:

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[0004] Rear projection screens and light diffusers are characterized by their ambient light rejection, resolution, gain, and contrast as properties which are determined by the structure and composition of the component materials. For example, the gain which is a measure of the intensity of transmitted light as a function of the viewing angle, is determined primarily by the index of refraction of the spherical beads and the surrounding medium. Similarly, the ambient light rejection and contrast of the light filter are determined largely by the ~~opacity~~ optical absorption of the binder layer. The resolution of the screen is determined by the size of the beads used and how they pack together in the lens system.

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[0005] However, the interdependence of certain optical properties and their dependence on the properties of component materials, limit optimization of the optical properties of basic refractive light filters. For example, if the ~~opacity~~ optical absorption of the binder layer is increased to enhance the ambient light rejection of the viewing surface, transmission of refracted image light through the binder layer in the transmission area of the bead will be reduced. In addition, the range of indices of refraction of available materials also limits the performance of such filters. Such interdependencies and material limitations hamper the performance of basic refractive filters.

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[0006] A multi-layer light filter in accordance with the present invention includes a single layer of glass or resin beads supported in an opaque layer and an additional contiguous light-dispersing support or backing layer that exhibits asymmetrical or anisotropic light-dispersing properties along axes perpendicular to the direction of

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propagation. "Anisotropic" and "asymmetrical" are used interchangeably to have the same meaning for purposes of this disclosure. This structure of optical components enhances the ~~diffusion~~ dispersion or scattering of light along one axes, for example the horizontal axis, and without changing the ~~diffusion~~ dispersion or scattering of light along an orthogonal axis, for example, the vertical axis. Such a structure promotes wider viewing angles as viewed along one (i.e., the horizontal) axis from the light output side of the support layer. Such structure also leaves unchanged viewing angles, as viewed along the other (i.e., vertical) axis from the light output side of the support layer.

[0021] Light **38** that is approximately collimated from an effectively distant image source (not shown) is incident on filter **10** at back surfaces **36** of beads **14** and back surface **19** of opaque binder layer **16** between the beads. These surfaces define an incident or image side of light filter **10**. Outer surface **18** of the support layer **12** defines a front or viewing side of light filter **10** through which viewers observer the transmitted image light. Thus, light incident on beads **14** is refracted, transmitted through the beads **14** and the associated transmission apertures **34**, and is asymmetrically dispersed to viewers through the support layer **12**. Light **38** incident on the back surface **19** of the opaque binder layer **16** between beads **14** is absorbed to reduce transmission of this light through the filter assembly **10**. Therefore, "opaque binder layer," "optical absorption binder layer," "light absorbing binder layer," "absorbing binder," and "absorbing layer" are used interchangeably to refer to layer **16** in this disclosure.

[0022] Referring now to FIG. **2**, there is shown a diagram of the paths followed by refracted light rays **22**, **24**, **26**, **28** incident on back surface **36** of bead **14** at various distances from optic axis **30**. Substantially collimated light rays **22**, **24**, **26**, **28** are refracted toward optic axis **30** by an angle Ψ that increases with the distance between a point of incidence **31** and optic axis **30**. Angle Ψ also increases with the index of

refraction of beads **14**. Refracted light rays **22, 24, 26, 28** are directed through transmission aperture **34**, which includes the point of contact between bead **14** and support layer **12** as well as the surrounding area where intervening opaque binder layer **16** is too thin to absorb refracted light rays **22, 24, 26, 28**. In contrast, non-collimated ~~or refracted~~ ray **29** ~~strikes the front surface of bead 14 and~~ tends to be refracted to outside of a transmission aperture **34** and ~~are~~ is absorbed by the opaque binder layer **16**.

[0026] Ambient light rejection measures how well ambient light incident on the viewing surface of a light filter is absorbed or transmitted relative to the amount re-dispersed back toward the viewer. This property depends primarily on the reflectivity of the front surface of the support layer **18**, the ~~opacity~~ optical absorption of binder layer **16** and the index of refraction of beads **14**. Ambient light reflected into viewers' eyes from filter **10** can significantly impair the quality of an image by reducing the contrast.

[0027] In the filter assembly **10** illustrated in Figure 1, ambient light incident on the viewing surface **18** may be reflected at the interfaces between: a) the opaque binder layer **16** and support layer **12**; b) the beads **14** and opaque binder layer **16**; and c) beads **14** and air at incident surface **36**. Of these, the air-bead interface may be most significant because the indices of refraction of support layer **12**, opaque binder layer **16**, and beads **14** can be made more nearly equal to minimize reflections from the first two interfaces. Ambient light rejection in the filter **10** of Figure 1 is affected by ~~opacity~~ optical absorption of binder layer **16**. However, increasing the ~~opacity~~ optical absorption of binder layer **16** to improve ambient light rejection decreases the amount of image light transmitted through the transmission apertures **34** around the point of contact between beads **14** and support layer **12**.

[0030] Referring now to Figure 6, there is shown another embodiment of a light filter **120** of the present invention comprising a single-layer array of light transmissive beads **14** structurally supported in an ~~opaque~~ absorbing binder layer **16** having a surface **19** through

which the beads **14** protrude to receive substantially collimated light **220** from an image source (not shown), and having a substantially flat interface surface **27** at which the beads **14** contact the support layer **12** of anisotropic dispersing properties. This allows transmission of the light **220** through a plurality of transmission apertures **34** and through the support layer **12** for viewing within different horizontal and vertical viewing angles. The beads **14** each have a radius about equal to a selected value R. The light filter **120** includes the transparent support layer **12** affixed to the surface **27** of the ~~opaque~~ absorbing binder layer **16**, with the filter surface **18** oriented toward the viewer (not shown). The light filter **120** also includes an additional conformal layer of light transmissive material **128** disposed over the protruding beads **14** to a substantially uniform thickness between about 0.1R and 1.0R, where such thickness is measured normal to the spherical surfaces **36** of the beads **14**. This conformal layer **128** can also cover the surface **19** of an opaque binder layer **16** between substantially contiguous beads **14**.

[0032] The conformal layer **128** presents increased incident surface to incoming light 220 and functions as a preliminary stage of convergent refraction of light **220** from the image source (not shown) into the beads **14**. This allows a greater portion of incident light to enter into the beads **14**, and such light **220** so converged is incident on the protruding surfaces **36** of the beads **14** above the ~~opaque~~ absorbing layer **16** at angles that allow a greater percentage of the light **220** to enter the beads **14** and propagate into the transmission apertures **34** of the beads **14**. Light emanating from the transmission apertures **34** is then asymmetrically or anisotropically dispersed by the support layer **12** for viewing through different horizontal and vertical viewing angles relative to the axis **11** that is normal to the viewing surface **18**. Thus, a greater percentage of the light **220** striking the back surfaces **36** of the beads **14** is transmitted through the filter surface **18** than is typically feasible with conventional single-layer light filters, which have a typical transmittance ~~within the horizontal viewing angles to~~ of about 35 percent.

[0037] The light filter **122** also includes a conformal layer **128** of light transmissive material disposed on the incident surfaces **36** of the beads **14** and surface **19** of an ~~opaque~~ absorbing binder layer **16**. The additional conformal layer **128** defines a substantially spherical or parabolic lens **131** behind each bead **14,** with local points or centers of curvature **342** disposed forward in the direction toward the source of incident light relative to the centers of curvature **340** of the beads **14**. The layer **128** thus has a non-uniform thickness as measured normally to the spherical protruding surfaces **36** of the beads **14**.

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[0038] The conformal layer **128** provides a preliminary stage of convergent refraction of the incident light **320, 322** into the beads **14.** Further, it is believed that displacing the centers of curvature **342** or the focal points of the incident surface **129** of layer **128** ~~forward~~ in the direction toward the source of incident light relative to the centers of curvature **340** of the beads 14 increases convergence of such light **320, 322** into the beads **14**, and converges such light into the beads **14** nearer to the ideal angles for refraction of such light **320, 322** through the transmission apertures **34**. This filter assembly ~~is believed to~~ exhibits transmittance of up to about 60 percent.

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[0039] The support layer **12** diffuses light emanating through transmission apertures **34** through different vertical and horizontal viewing angles relative to axis **30** normal to the viewing surface **18**, as previously described with reference to Figure 3. Alternatively, the support layer **12** may comprise a thin film of such anisotropical dispersing material, as previously described with reference to Figure 3, disposed on a thick layer of transparent material (on either side) to form a composite support layer for improved sturdiness of the light filter **120**. The support layer **12** is affixed to the thin transparent layer **15** which, in turn, is affixed to the surface **27** of the ~~opaque~~ absorbing binder layer **16**, with the viewing surface **18** oriented toward the viewer (not shown).

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[0040] The index of refraction of the beads **14** is preferably selected to be from 1x to 1.3x index of refraction of the conformal layer **128** for increasing transmission of image light into the beads **14**. Suitable materials for the conformal layer **128** include polymethylmethacrylate and thermoplastic polyurethane (TPU), and similar clear thermoplastic materials. For example, a conformal layer **128** with an index of refraction of about 1.5 can be fabricated for either of these two materials, and the beads **14** can be fabricated from glass or resinous material selected with an index of refraction in a range between about 1.5 and 1.94. The conformal layer **128** beneficially reduces the difference, or mis-match in indices of refraction encountered by light **320**, **322** at the interface with the incident surface **36** of the beads **14**. This increases the transmittance of the ~~beads 14~~ filter. Gain control can also be provided, by controlling the thickness and/or selectively shaping the incident surface **129** of the conformal layer **128** in the manner described above. In an alternative embodiment of the present invention, a layer of anisotropic or asymmetrical light diffusing material of the type previously described herein with reference to layer **12** may be use to asymmetrically disperse the incident light over a greater angle along the horizontal axis than along the vertical axis.

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[0041] One process of the present invention for making light filter **122** of the embodiment illustrated in Figure 8 uses an ~~opaque~~ absorbing binder such as thermoplastic resin uniformly mixed with a colorant such as carbon black, a plurality of light transmissive beads **14** each of radius R, and a thin layer **15** of transparent material having a uniform thickness selected between about 0.1R and 0.5R, and a support layer **12** of anisotropically diffusing film **12**. The ~~opaque~~ absorbing binder is selected to have a viscous unset state and substantially rigid set state, and the thin transparent material in layer **15** is selected to have a deformable semi-viscous unset state and substantially rigid set state. The process includes depositing a layer of the ~~opaque~~ absorbing binder in the unset state on the thin transparent layer **15** which is disposed on the incident surface of

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the asymmetrical diffusing support layer to a total thickness above the support layer **12** that is about 0.3 to 0.8 R. The plurality of light transmissive beads **14** are arranged in a single layer array on the surface **19** of the ~~opaque~~ absorbing binder to then penetrate the plurality of light transmissive beads **14** into the layer of ~~opaque~~ absorbing binder **16** and through the thin layer **15** to the ~~support~~ transparent layer **12**. The opaque binder layer **16** is then activated into the set state for supporting the light transmissive beads **14** in position with the transmission apertures **34** of the beads **14** in contact with the asymmetrical diffusing layer **12**. A layer of light transmissive material **128** in the unset state is disposed on protruding surfaces **36** of the beads **14**, pressure is applied to the layer of light transmissive material **128** to substantially conform the layer to the shapes of protruding portions of the beads **14** and laminate the conformal layer to the beads **14** and the ~~opaque~~ absorbing binder **19**. The layer of light transmissive material **128** is activated into the set state in a conventional manner for binding the layer **128** to the beads **14**. Layering the ~~opaque~~ absorbing layer **16** and thin transparent layer **15** as illustrated and described herein assures that portions of the incident surfaces **36** of the beads **14** protrude from the ~~opaque~~ absorbing binder. The deformable semi-viscous state of the light transmissive layer beneficially allows ~~the layer~~ it to conform to the shapes of these protruding portions of the beads **14** and retain the shape of defined lenses **131** with centers of curvature forward of the centers of curvature of the beads **14**. Radii of curvature of these lenses **131** can also be adjusted in this manner. This process may result in a non-uniform thickness in the layer **128** measured normally to the incident surfaces **36** of the beads **14**. Alternatively, a small quantity of light transmissive material may be centrally deposited on upper crests of the protruding beads **14** prior to depositing the layer **128** of light transmissive material in the unset state on protruding incident surfaces **36** of the beads **14**. The combined volumes of transparent materials on the incident surfaces **36** of the beads **14** migrate together under heat and/or pressure to form the diffusion lenses as previously described on the incident surfaces **36** of each bead **14**.

[0042] In another embodiment of the present invention, the asymmetrical gain of the filter may be enhanced along one axis relative to another orthogonal axis using a structure as partially illustrated in Figure 9. Specifically, the sectional view of the filter illustrated in this figure (i.e., as a top sectional view) shows a layer **399** of prismatic 'lenses' **400** having planar or plateau faces **402** and faceted or angular sloped faces **404**, **406** in iterative, contiguous orientations along, for example, the horizontal axis of the filter. In this embodiment, the layer **399** of prismatic 'lenses' is disposed to receive incident collimated light rays A, B from a light source (not shown). Rays A impinging upon the plateau faces **402** are transmitted through the layer without deviation, and the dispersion of light via the successive segments of the filter including a beaded layer proceeds as previously described. However, collimated light rays B impinging upon the sloped faces **404**, **406** are deviated from the incident orientation ~~(by as much as about 20°)~~ to provide additional dispersion through the successive segments of the filter including a beaded layer as previously described, with resultant wider viewing angle θ_2 along the horizontal axis. The horizontal angle may be adjusted by changing the size of the plateau faces **402** and the angles of the sloping faces **404**, **406**. It should be noted that enhanced viewing angle, for example, along the horizontal axis may be so enhanced with the prismatic layer **399** disposed before or after a beaded segment of the filter, and with the prismatic surfaces **402**, **404**, **406** facing in either direction relative to the axis of incident light. Also, the spacing shown between the prismatic layer **399** and beaded segment of filter on support layer 12 is illustrative only, and such spacing may be zero for a contiguous, layered structure.

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